DIFFUSION IMAGE ANALYSIS IN NA-MIC

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Keywords: Diffusion Image Analysis, fiber segmentation

Neuroimaging studies over the last two decades have led to major progress in delineating gray matter abnormalities in schizophrenia. By comparison, far less is known about white matter abnormalities in schizophrenia, especially those affecting white matter fiber tracts that connect the frontal and temporal lobes, tracts that have long been thought to be abnormal in this disorder. With the development of diffusion tensor imaging (DTI), however, we are now able to investigate more fruitfully white matter abnormalities in schizophrenia. As part of the NA-MIC project we have focused on white matter fronto-temporal connections, including the uncinate fasciculus, arcuate fasciculus, and cingulum bundle. One example of this work is our collaboration with computer scientists at Brigham and Women's Hospital and MIT, where we have developed diffusion tensor based anisotropy measures to characterize white matter abnormalities in schizophrenia. Here, we present findings from this collaboration where we have applied anisotropy measures to quantify diffusion properties of fronto-temporal fiber bundles (cingulum bundle, fornix, uncinate fasciculus and inferior occipito-frontal fasciculus). Additionally, we note that an important challenge in DTI is to be able to automatically segment white matter into known fiber bundles. Fiber tractography has begun to fill this niche and is a central tool for tracing fibers over the entire brain. However, the resulting fibers still need to be organized in an anatomically meaningful way. Accordingly, and in collaboration with computer scientists at MIT, we have developed a new algorithm to automatically segment fibers into organized and meaningful fiber bundles (O'Donnell). Moreover, we note that quantifying properties of a bundle by analyzing individual fibers can be cumbersome. To address this issue, and in a team effort with collaborators from Brigham and Women's Hospital, we have developed a novel method to provide a continuous representation of each bundle. This new representation greatly facilitates the computation of geometric and diffusion properties over an entire fiber bundle. We are currently in the process of applying these new techniques to study white matter properties in schizophrenia.

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